

## CLAIMS

What is claimed is:

1. A charge pump circuit comprising:  
charge pumping capacitance;  
5 switches that vary voltage across the pumping capacitance to provide a pumped output voltage from an input voltage; and  
a clamp circuit between the input and output to prevent the output voltage from being significantly below the input voltage.
- 10 2. A charge pump circuit as claimed in claim 1 wherein the clamp comprises a transistor.
3. A charge pump circuit as claimed in claim 2 wherein the transistor is controlled by a comparator.
- 15 4. A charge pump circuit as claimed in claim 3 wherein the comparator exhibits hysteresis.
5. A charge pump circuit as claimed in claim 2 wherein the transistor is controlled by an amplifier.
- 20 6. A charge pump circuit as claimed in claim 2 wherein the transistor is a field effect transistor.
- 25 7. A charge pump circuit as claimed in claim 1 included in a controller, the clamp circuit preventing the output voltage from being below the input voltage by an amount which would cause the controller to malfunction.

8. A charge pump circuit as claimed in claim 1 wherein the clamp circuit prevents the output voltage from being more than .2 volts below the input voltage.
- 5 9. A controller comprising:  
charge pumping capacitance;  
switches that vary voltage across the pumping capacitance to provide a pumped output voltage from an input voltage; and  
a clamp circuit between the input and output to prevent the output  
10 voltage from being significantly below the input voltage.
10. A controller as claimed in claim 9 wherein the clamp comprises a transistor.
- 15 11. A controller as claimed in claim 10 wherein the transistor is controlled by a comparator.
12. A controller as claimed in claim 11 wherein the comparator exhibits hysteresis.  
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13. A controller as claimed in claim 10 wherein the transistor is controlled by an amplifier.
14. A controller as claimed in claim 10 wherein the transistor is a field effect  
25 transistor.
15. A charge pump circuit as claimed in claim 9 wherein the clamp circuit prevents the output voltage from being below the input voltage by an amount which would cause the controller to malfunction.

16. A charge pump circuit as claimed in claim 9 wherein the clamp circuit prevents the output voltage from being more than .2 volts below the input voltage.
- 5 17. A DC/DC converter comprising:  
controlled switches; and  
a controller that controls the controlled switches, the controller comprising:  
charge pumping capacitance;  
10 switches that vary voltage across the pumping capacitance to provide a pumped output voltage to the controller from an input voltage; and  
a clamp circuit between the input and output to prevent the output voltage from being significantly below the input.
- 15 18. A DC/DC converter as claimed in claim 13 wherein the clamp comprises a transistor.
19. A DC/DC converter as claimed in claim 14 wherein the transistor is  
20 controlled by a comparator.
20. A DC/DC converter as claimed in claim 15 wherein the comparator exhibits hysteresis.
- 25 21. A DC/DC converter as claimed in claim 14 wherein the transistor is controlled by an amplifier.
22. A DC/DC converter as claimed in claim 14 wherein the transistor is a field effect transistor.

23. A charge pump circuit as claimed in claim 17 wherein the clamp circuit prevents the output voltage from being below the input voltage by an amount which would cause the controller to malfunction.
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24. A charge pump circuit as claimed in claim 17 wherein the clamp circuit prevents the output voltage from being more than .2 volts below the input voltage.
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25. A method of charge pumping comprising:  
varying voltage across a pumping capacitance to provide a pumped output voltage from an input voltage; and  
clamping the output voltage to prevent the output voltage from being significantly below the input voltage.
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26. A method as claimed in claim 25 wherein the output voltage is clamped by a transistor between the input voltage and output voltage.
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27. A charge pump circuit as claimed in claim 26 wherein the transistor is controlled by a comparator.
28. A charge pump circuit as claimed in claim 27 wherein the comparator exhibits hysteresis.
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29. A charge pump circuit as claimed in claim 26 wherein the transistor is controlled by an amplifier.
30. A charge pump circuit as claimed in claim 26 wherein the transistor is a field effect transistor.

- 5           31.     A method as claimed in claim 25 further comprising applying the pumped output voltage to a controller, the clamping preventing the output voltage from being below the input voltage by an amount which would cause the controller to malfunction.
32.     A method as claimed in claim 25 wherein the clamping prevents the output voltage from being more than .2 Volt below the input voltage.
- 10          33.     A method of converting DC voltage to DC voltage comprising:  
              varying voltage across a pumping capacitance to provide a pumped output voltage from an input voltage;  
              clamping the output voltage to prevent the output voltage from being significantly below the input voltage;  
15               applying the output voltage to a controller; and  
              controlling converter switches from the controller.
34.     A method as claimed in claim 33 wherein the output voltage is clamped by a transistor between the input voltage and output voltage.
- 20          35.     A charge pump circuit as claimed in claim 34 wherein the transistor is controlled by a comparator.
36.     A charge pump circuit as claimed in claim 35 wherein the comparator exhibits hysteresis.
- 25          37.     A charge pump circuit as claimed in claim 34 wherein the transistor is controlled by an amplifier.

38. A charge pump circuit as claimed in claim 34 wherein the transistor is a field effect transistor.

5 39. A method as claimed in claim 33 wherein the clamping prevents the output voltage from being below the input voltage by an amount which would cause the controller to malfunction.

40. A method as claimed in claim 33 wherein the clamping prevents the output voltage from being more than .2 Volt below the input voltage.

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41. A charge pump comprising:  
means for varying voltage across a pumping capacitance to provide a pumped output voltage from an input voltage; and  
means for clamping the output voltage to prevent the output voltage from  
15 being significantly below the input voltage.

42. A controller comprising:  
means for varying voltage across a pumping capacitance to provide a pumped output voltage from an input voltage; and  
20 means for clamping the output voltage to prevent the output voltage from being significantly below the input voltage.

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43. A DC/DC converter comprising:  
means for varying voltage across a pumping capacitance to provide a pumped output voltage from an input voltage;  
25 means for clamping the output voltage to prevent the output voltage from being significantly below the input voltage;  
means for applying the output voltage to a controller; and  
means for controlling converter switches from the controller.

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